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Light-attracted hawkmoths (Lepidoptera: Sphingidae) of Boracéia, municipality of Salesópolis, state of São Paulo, Brazil.

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Abstract: The light-attracted hawkmoths (Lepidoptera: Sphingidae) of the *Estação Biológica de Boracéia*, municipality of Salesópolis, state of São Paulo, Brazil were sampled during a period of 64 years (1940-2004). A total of 2,064 individuals belonging to 3 subfamilies, 6 tribes, 23 genera and 75 species were identified. Macroglossinae was the most abundant and richest subfamily in the study area, being followed by Sphinginae and Smerinthinae. About 66 % of the sampled individuals were assorted to the macroglossine tribes Dilophonotini and Macroglossini. Dilophonotini (Macroglossinae) was the richest tribe with 26 species, followed by Sphingini (Sphinginae) with 18 species, Macroglossini (Macroglossinae) with 16 species, Ambulycini (Smerinthinae) and Philampelini (Macroglossinae) with seven species each one, and Acherontiini (Sphinginae) with only one species. *Manduca* Hübner (Sphinginae) and *Xylophanes* Hübner (Macroglossinae) were the dominant genera in number of species. Only *Xylophanes thyelia thyelia* (Linnaeus) and *Adhemarius eurysthenes* (R. Felder) were recorded year round

Introduction

Hawkmoths (Lepidoptera: Sphingidae) comprise about 200 genera and 1300 species (Kitching and Cadiou 2000). They are distributed throughout the world, except Antarctica and Greenland (Moré et al. 2005). Approximately one third of these moths belong to the Neotropical fauna (Heppner 1991; 1998). In Brazil, they are represented by 29 genera and 210 species (compilation of Rothschild and Jordan 1910; Moss 1920; Hambleton and Forbes 1935; Oiticica 1939; 1942; Zikán and Zikán 1968; Laroca and Mielke 1975; Schreiber 1978; Biezanko 1981; Ferreira et al. 1986; Laroca et al. 1989; Motta et al. 1991; 1998; Carcasson and Heppner 1996; Motta and Soares 1997; Marinoni et al. 1999; Oliveira et al. 1999; Brown and Freitas 2000; Corseuil et al. 2001; Duarte Jr. et al. 2001; Motta and Andreazze 2001; 2002; Becker 2001; Soares and Motta 2002; Darrault and Schlindwein 2002; Gusmão et al. 2003; Gusmão and Creão-Duarte 2004a; b; Duarte Jr. and Schlindwein 2005; Motta and Xavier-Filho 2005).

Hawkmoths have long been recognized as major pollinators of flowering plants (Baker 1961; Gregory 1963; Silberbauer-Gottsberger and Gottsberger 1975; Janzen 1984; Haber and Frankie 1989; Darrault and Schlindwein 2002; Kitching 2002). Because of their capability to fly far away, these moths are potential long distance pollen dispersers (Linhart and Mendenhall 1977; Nilsson et al. 1992; Chase et al. 1996). They may be diurnal, crepuscular or nocturnal. In South America, however, most species are more active at night, when they may be easily observed visiting flowers with white or pale corollas, very long tubes or spurs and copious amounts of nectar (Silberbauer-Gottsberger and Gottsberger 1975; Baker and Baker 1983; Haber and Frankie 1989).

According to some authors (e.g. Minet 1994; Carcasson and Heppner 1996; Lemaire and Minet 1998; Kitching and Cadiou 2000), the hawkmoths are classified in three subfamilies each with at least one genus occurring in Brazil. Smerinthinae has three tribes (*sensu* Kitching and Cadiou 2000), but only Ambulycini is represented in Brazil, comprising the genera *Adhemarius* Oiticica, 1939, *Orecta* Rothschild & Jordan, 1903 and *Protambulyx* Rothschild & Jordan, 1903. Sphinginae includes the tribes Acherontiini and Sphingini. *Agrius cingulata* (Fabricius, 1775), a very common and recognizable species, is the only acherontine hawkmoth recorded to the New World (Kitching 2002). In the same region, the

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Sphingini are represented by the genera *Amphimoea* Rothschild & Jordan, 1903, *Cocytius* Hübner, [1819], *Manduca* Hübner, [1807], *Neococytius* Hodges, 1971, *Neogene* Rothschild & Jordan, 1903, and *Sphinx* Linnaeus, 1758. Macroglossinae is considered here according to Kitching and Cadiou (2000) after Derzhavets (1984), who recognized the tribes Dilophonotini, Philampelini and Macroglossini. The monophyly of none of these tribes is yet clearly supported. In Brazil they are represented by at least one genus. Dilophonotini includes the highest number of genera (16). Philampelini is represented exclusively by the genus *Eumorpha* Hübner, [1807], while Macroglossini has two genera, *Hyles* Hübner, [1819] and *Xylophanes* Hübner, [1819].

Since sphingids can easily be recorded by light-trapping and are taxonomically well known (Kitching and Cadiou 2000), they have served as model organisms in a number of diversity studies (e.g. León-Cortés et al. 1998). Considering that the sphingids of the state of São Paulo are still poorly known, the purpose of this work is to document the composition, relative abundance, and phenology of the sphingid fauna of a natural reserve at Boracéia, municipality of Salesópolis, which is well preserved and located approximately 80 km east of the city of São Paulo. A long-term survey with a smaller and better known group of macrolepidopterans, *viz.* Saturniinae (Saturniidae), has revealed how important this reserve may be to the maintenance of the lepidopterofauna of São Paulo (as well as for other organisms, see Heyer et al. 1990). Of the 11 saturniine species hitherto recorded in the state of São Paulo (data gathered from Lemaire 1978), 10 have been sampled in Boracéia (M. Duarte and collaborators, in progress).

Materials and methods

Study Site

The survey of the hawkmoths (Sphingidae) of Boracéia was conducted at the *Estação Biológica de Boracéia* (EBB), municipality of Salesópolis, state of São Paulo, Brazil (23°38'S, 45°52'W; 900 m a.s.l.; see map in Heyer et al. 1990). This station has been supported and administrated by the *Museu de Zoologia*, *Universidade de São Paulo* (details on the site http://www.mz.usp.br). The EBB is in a 16,450 ha reserve of the *Companhia de Saneamento Básico do Estado de São Paulo*. Even before its establishment in March of 1954, the reserve has been a reference site for anyone interested in moths and butterflies of Atlantic Rainforest (Travassos and Camargo 1958). According to Setzer (1946), Boracéia is among the wettest areas in Brazil; average annual rainfall is usually above 1,500 mm (Leemans and Cramer 1991). The vegetation is relatively continuous except for the gaps formed by the narrow dirt access road, the aqueduct line, several small rivers and the small man-made clearings around the station itself (Heyer et al. 1990). The forest has a low canopy, averaging ca. 5-10m. Palm trees (especially *Euterpe edulis*), tree ferns and giant bamboos (*Merostachys*) are common. The understory is relatively open in most parts of the forest, being more dense along streams, where the presence of the plant genus *Heliconia* is characteristic (Bertoluci and Rodrigues 2002). There are 240 species of trees, 130 shrubs, 115 epiphytes, 90 lianas, and 89 herbs in the area (Wilms 1995 *apud* Bertoluci and Rodrigues 2002).

Data Collection

The first and most extensive collections of Lepidoptera from Boracéia were made by the entomologists Romualdo Ferreira D'Almeida and Lauro Travassos Filho in the 1940's and 1950's (Travassos and Camargo 1958). However, only in 1948 and 1949, the hawkmoths were monthly sampled, with 78 and 85 days of field work, respectively (Travassos and Camargo 1958; M. Duarte and collaborators, in progress). Moth sampling extended through the following decades until 2004 (Table 1). The hawkmoths were attracted with mixed mercury vapor bulbs and manually collected on the walls of the scientist's residence (one of the EBB's buildings; for details see Travassos and Camargo 1958). They were killed by direct injection of aqueous ammonia solution in the thorax (specimens collected before 2004 may have been killed with different techniques – see Winter Jr. 2000). All specimens sampled from September of 1940 to April of 2004 were sorted and identified, and their records were included in a digitized database, which is intended to be of free public access through the World Wide Web.

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Table 1. Years and months of hawkmoth sampling (Lepidoptera: Sphingidae) at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil.

	January	February	March	April	May	June	July	August	September	October	November	December
1940									X		X	
1941										X	X	
1942		X		X					X		X	
1943										X		X
1946							X					
1947						X			X		X	
1948	X	X	X	X	X	X	X	X	X	X	X	X
1949	X	X	X	X	X	X	X	X	X	X	X	X
1950	X	X	X						X			
1951											X	
1952	X				X							
1953									X		X	
1954								X	X	X		
1955	X											
1957	X		X	X						X	X	
1958	X		X								X	X
1959		X				X	X				X	
1961	X									X		
1962							X				X	
1963										X		
1964	X										X	X
1965		X		X		X	X	X	X	X	X	X
1966	X					X		X	X	X		
1967	X		X				X	X		X	X	X
1968	X	X	X	X	X			X	X	X		X
1969	X							X		X		
1970										X		
1983										X		
1985										X		
1987										X		
1989										X		
1991										X		
1993												X
1995										X		
1997				X								
1999				X								
2004				X								

Species identification was based on literature (Rothschild 1903; D'Abrera 1986). Eitschberger (2006) has recently revalidated the genus *Amphonyx* Poey (type species: *A. duponchel* Poey, 1832) (Sphinginae: Sphingini), for which there is no evidence supporting its monophyly (Kitching 2002). Eitschberger (*op. cit.*) also erected the monotypic genus *Pseudococytius* for *Amphonyx beelzebuth* Boisduval, [1875], and the monotypic genus *Morcocytius* for *Cocytius mortuorum* Rothschild & Jordan, 1910. In the same paper, *Cocytius* Hübner is redefined as a monotypic genus (type species: *Sphinx antaeus* Drury, 1773). For practical reasons, the taxonomic arrangement adopted in Eitschberger (2006) will be addressed elsewhere. In the present paper, nomenclature follows Kitching and Cadiou (2000). Voucher specimens are deposited at the *Museu de Zoologia da Universidade de São Paulo*, Brazil.

Results and discussion

A total of 2,064 individuals (473 females and 1591 males) belonging to 3 subfamilies, 6 tribes, 23 genera, and 75 species were sampled in the EBB, from 1940 to 2004 (Tables 2 and 3). Macroglossinae is the most abundant subfamily with 66 % of the collected material, being followed by Sphinginae (23 %), and Smerinthinae (11 %).

In all localities surveyed in Brazil, macroglossines overcome other sphingids in number of individuals (e.g. Laroca and Mielke 1975; Ferreira et al. 1986; Laroca et al. 1989; Motta et al. 1991; 1998; Marinoni et al. 1999; Darrault and Schlindwein 2002; Motta and Xavier-Filho 2005), and more than 50 % of these macroglossines belong to the tribes Dilophonotini and Macroglossini (Figure 1A).

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Table 2. Number of species and individuals per each hawkmoth genus (Lepidoptera: Sphingidae) recorded at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil, from 1940 to 2004.

Subfamilies	Tribes	Genera	Number of species	Number of individuals		
				Female	Male	Total
Smerinthinae	Ambulycini	*Adhemarius*	5	37	167	204
		Protambulyx	2	10	14	24
Sphinginae	Sphingini	*Amphimoea*	1	1	0	1
		Cocytius	4	53	47	100
		Manduca	11	45	226	271
		Neococytius	1	27	21	48
		Sphinx	1	1	18	19
	Acherontiini	*Agrius*	1	10	24	34
Macroglossinae	Dilophonotini	*Aellopos*	2	3	4	7
		Callionima	3	8	67	75
		Enyo	2	21	28	49
		Erinnyis	6	75	176	251
		Hemeroplanes	2	0	4	4
		Isognathus	1	1	0	1
		Madoryx	1	0	1	1
		Nyceryx	3	4	38	42
		Pachylia	2	8	6	14
		Pachylioides	1	10	11	21
		Perigonia	2	3	55	58
		Pseudosphinx	1	20	22	42
	Philampelini	*Eumorpha*	7	46	155	201
	Macroglossini	*Hyles*	1	0	1	1
		Xylophanes	15	90	506	596
Total	6	23	75	473	1591	2064

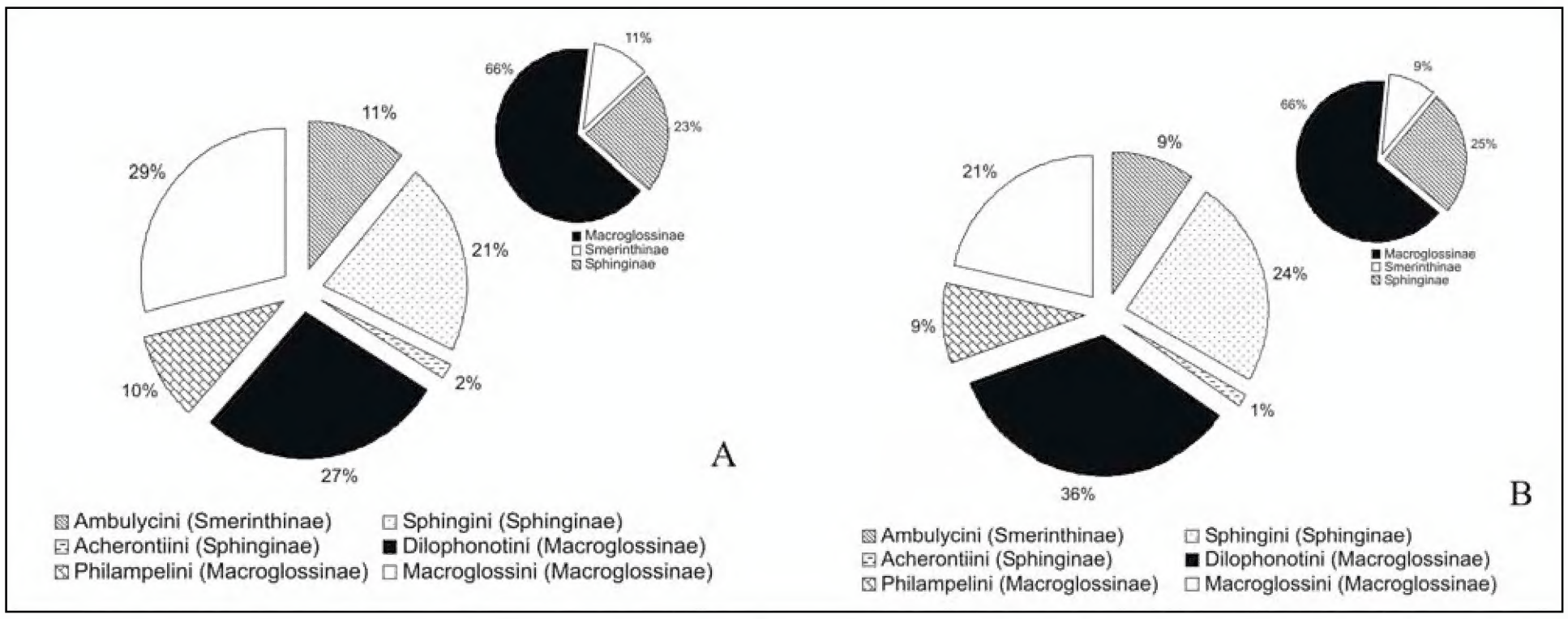

Figure 1. Relative proportions in the number of individuals and species collected per subfamilies and tribes at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil, from 1940 to 2004. A, relative abundance; B, species richness.

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Table 3. List of the hawkmoths (Lepidoptera: Sphingidae) collected at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil, from 1940 to 2004.

	Genera	Species	Subspecies	Authorship
1	*Adhemarius*	*daphne*	*daphne*	(Boisduval, [1875])
2	*Adhemarius*	*eurysthenes*		(R. Felder, [1874])
3	*Adhemarius*	*gagarini*		(Zikán, 1935)
4	*Adhemarius*	*gannascus*		(Stoll, 1790)
5	*Adhemarius*	*palmeri*		(Boisduval, [1875])
6	*Aellopos*	*fadus*		(Cramer, 1775)
7	*Aellopos*	*titan*	*titan*	(Cramer, 1777)
8	*Agrius*	*cingulata*		(Fabricius, 1775)
9	*Amphimoea*	*walkeri*		(Boisduval, [1875])
10	*Callionima*	*inuus*		(Rothschild & Jordan, 1903)
11	*Callionima*	*nomius*		(Walker, 1856)
12	*Callionima*	*parce*		(Fabricius, 1775)
13	*Cocytius*	*antaeus*		(Drury, 1773)
14	*Cocytius*	*beelzebuth*		(Boisduval, [1875])
15	*Cocytius*	*duponchel*		(Poey, 1832)
16	*Cocytius*	*lucifer*		Rothschild & Jordan, 1903
17	*Enyo*	*lugubris*	*lugubris*	(Linnaeus, 1771)
18	*Enyo*	*ocypete*		(Linnaeus, 1758)
19	*Erinnyis*	*alope*	*alope*	(Drury, 1773)
20	*Erinnyis*	*crameri*		(Schaus, 1898)
21	*Erinnyis*	*ello*	*ello*	(Linnaeus, 1758)
22	*Erinnyis*	*lassauxii*		(Boisduval, 1859)
23	*Erinnyis*	*obscura*	*obscura*	(Fabricius, 1775)
24	*Erinnyis*	*oenotrus*		(Cramer, 1780)
25	*Eumorpha*	*analis*		(Rothschild & Jordan, 1903)
26	*Eumorpha*	*anchemolus*		(Cramer, 1779)
27	*Eumorpha*	*fasciatus*	*fasciatus*	(Sulzer, 1776)
28	*Eumorpha*	*labruscae*	*labruscae*	(Linnaeus, 1758)
29	*Eumorpha*	*megaeacus*		(Hübner, [1819])
30	*Eumorpha*	*obliquus*	*obliquus*	(Rothschild & Jordan, 1903)
31	*Eumorpha*	*translineatus*		(Rothschild, 1895)
32	*Hemeroplanes*	*longistriga*		(Rothschild & Jordan, 1903)
33	*Hemeroplanes*	*ornatus*		Rothschild, 1894
34	*Hyles*	*euphorbiarum*		(Guérin-Méneville & Percheron, 1835)
35	*Isognathus*	*caricae*	*caricae*	(Linnaeus, 1758)
36	*Madoryx*	*plutonius*	*plutonius*	(Hübner, [1819])
37	*Manduca*	*albiplaga*		(Walker, 1856)
38	*Manduca*	*brasilensis*		(Jordan, 1911)
39	*Manduca*	*dalica*	*anthina*	(Jordan, 1911)
40	*Manduca*	*diffissa*	*petuniae*	(Boisduval, [1875])
41	*Manduca*	*florestan*		(Stoll, 1782)
42	*Manduca*	*hannibal*		(Cramer, 1779)
43	*Manduca*	*incisa*		(Walker, 1856)
44	*Manduca*	*lichenea*		(Burmeister, 1855)
45	*Manduca*	*lucetius*		(Cramer, 1780)
46	*Manduca*	*rustica*	*rustica*	(Fabricius, 1775)
47	*Manduca*	*sexta*	*paphus*	(Cramer, 1779)
48	*Neococytius*	*cluentius*		(Cramer, 1775)
49	*Nyceryx*	*coffaeae*		(Walker, 1856)
50	*Nyceryx*	*continua*	*continua*	(Walker, 1856)
51	*Nyceryx*	*nictitans*	*nictitans*	(Boisduval, [1875])
52	*Pachylia*	*ficus*		(Linnaeus, 1758)

Table 3. Continued.

	Genera	Species	Subspecies	Authorship
53	*Pachylia*	*syces*	*syces*	(Hübner, [1819])
54	*Pachylioides*	*resumens*		(Walker, 1856)
55	*Perigonia*	*passerina*		Boisduval, [1875]
56	*Perigonia*	*stulta*		Herrich-Schäffer, [1854]
57	*Protambulyx*	*eurycles*		(Herrich-Schäffer, [1854])
58	*Protambulyx*	*strigilis*		(Linnaeus, 1771)
59	*Pseudosphinx*	*tetrio*		(Linnaeus, 1771)
60	*Sphinx*	*justiciae*		Walker, 1856
61	*Xylophanes*	*aglaor*		(Boisduval, [1875])
62	*Xylophanes*	*ceratomioides*		(Grote & Robinson, 1867)
63	*Xylophanes*	*chiron*	*nechus*	(Cramer, 1777)
64	*Xylophanes*	*indistincta*		Closs, 1915
65	*Xylophanes*	*isaon*		(Boisduval, [1875])
66	*Xylophanes*	*loelia*		(Druce, 1878)
67	*Xylophanes*	*marginalis*		Clark, 1917
68	*Xylophanes*	*pistacina*		(Boisduval, [1875])
69	*Xylophanes*	*pluto*		(Fabricius, 1777)
70	*Xylophanes*	*porcus*	*continentalis*	Rothschild & Jordan, 1903
71	*Xylophanes*	*schausi*	*schausi*	(Rothschild, 1894)
72	*Xylophanes*	*tersa*	*tersa*	(Linnaeus, 1771)
73	*Xylophanes*	*thyelia*	*thyelia*	(Linnaeus, 1758)
74	*Xylophanes*	*titana*		(Druce, 1878)
75	*Xylophanes*	*xylobotes*		(Burmeister, 1878)

Macroglossinae is also the richest subfamily in the EBB with 49 species (66 %). Sphinginae and Smerinthinae appear in second and third positions, respectively, with 19 (25 %) and 7 species (9 %) (Figure 1B). The tribe Dilophonotini (Macroglossinae) comprises 36 % of all species. Sphingini (Sphinginae) consists of 18 species (24 %), and is followed by Macroglossini (Macroglossinae) with 16 species (21%), Ambulycini (Smerinthinae) and Philampelini (Macroglossinae) with 7 species each one (9 %), and Acherontiini (Sphinginae) with only one species (1 %) (Figure 1B). These species richness distributions are rather similar to other localities hitherto surveyed in Central and South America (Laroca and Mielke 1975). In America North of Mexico, however, these moths are distinctly distributed. Most species belong to the tribe Sphingini, and the species richnesses of Dilophonotini and Macroglossini tend to be considerably lower (Hodges 1971; Laroca and Mielke 1975). On a world scale, Macroglossini represents the richest tribe, followed by Ambulycini, Sphingini, Philampelini, and Acherontiini (modified from Hodges 1971).

The genera *Manduca* Hübner, [1807] (Sphinginae: Sphingini) and *Xylophanes* Hübner, [1819] (Macroglossinae: Macroglossini) are dominant in EBB. They are represented by 11 and 15 species, respectively. Among all other localities in Brazil, where the sphingid fauna has been studied, only in Piracicaba, state of São Paulo, there is a genus, *Erinnyis* Hübner, [1819] (Macroglossinae: Dilophonotini), that surpasses in number of species both *Manduca* and *Xylophanes* (see Coelho et al. 1979).

Xylophanes is currently the largest genus in the family and comprises 97 valid species restricted to the New World (Kitching and Cadiou 2000; Cadiou 2000; Eitschberger 2001a; 2001b; Alvarez Corral 2001; Soares and Motta 2002; Vaglia and Haxaire 2003; Haxaire 2003; Haxaire and Eitschberger 2003; Haxaire and Vaglia 2004; Haxaire and Eitschberger 2007). Its dominance in number of species has been considered typical of the sphingid communities in very humid tropical and subtropical forests (Laroca and Mielke 1975).

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The species frequency distributions are shown in Figure 2 (see also Table 4). As is noted, the number of rare species is much higher than that of common species. This is typical of organism communities in a complex and relatively stable ecosystem (Preston 1948; 1960). Fourteen species are represented by only one individual in the collection: Smerinthinae: *Adhemarius daphne daphne* (Boisduval, [1875]), *Adhemarius gagarini* (Zikán, 1935), *Adhemarius palmeri* (Boisduval, [1875]); Sphinginae: *Amphimoea walkeri* (Boisduval, [1875]), *Manduca hannibal* (Cramer, 1779), *Manduca incisa* (Walker, 1856); Macroglossinae: *Hemeroplanes ornatus* Rothschild, 1894, *Hyles euphorbiarum* (Guérin-Méneville & Percheron, 1835), *Isognathus caricae caricae* (Linnaeus, 1758), *Madoryx plutonius plutonius* (Hübner, [1819]), *Pachylia syces syces* (Hübner, [1819]), *Xylophanes indistincta* Closs, 1915, *Xylophanes loelia* (Druce, 1878), and *Xylophanes schausi schausi* (Rothschild, 1894).

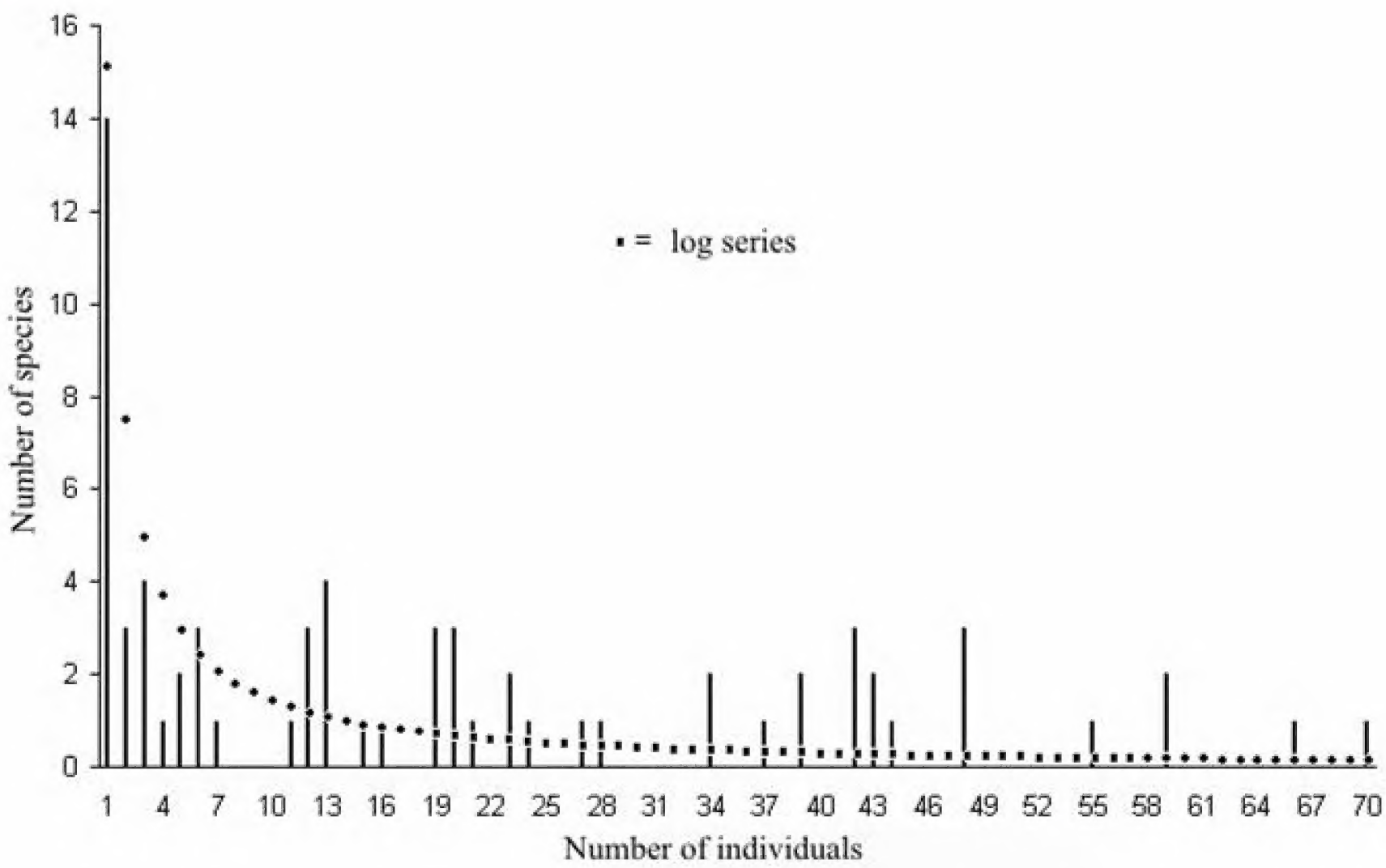

Figure 2. Species frequency distributions (observed and calculated by means of Fisher's log series) of hawkmoths (Lepidoptera: Sphingidae) with different number of individuals collected at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil.

Xylophanes t. thyelia (Linnaeus, 1758) (Macroglossinae: Macroglossini) was the most collected hawkmoth in the EBB (Figure 3). This species occurs year-round with *Adhemarius eurysthenes* (R. Felder, [1874]) (Smerinthinae: Ambulycini) (Table 5). Six other species appear to be constant in the EBB, although they have not been recorded in only one month during the 64 years of sampling (Table 3): Smerinthinae: *Adhemarius gannascus* (Stoll, 1790); Sphinginae: *Cocytius duponchel* (Poey, 1832); Macroglossinae: *Erinnyis crameri* (Schaus, 1898), *Xylophanes aglaor* (Boisduval, [1875]), *X. chiron nechus* (Cramer, 1777), and *X. xylobastes* (Burmeister, 1878).

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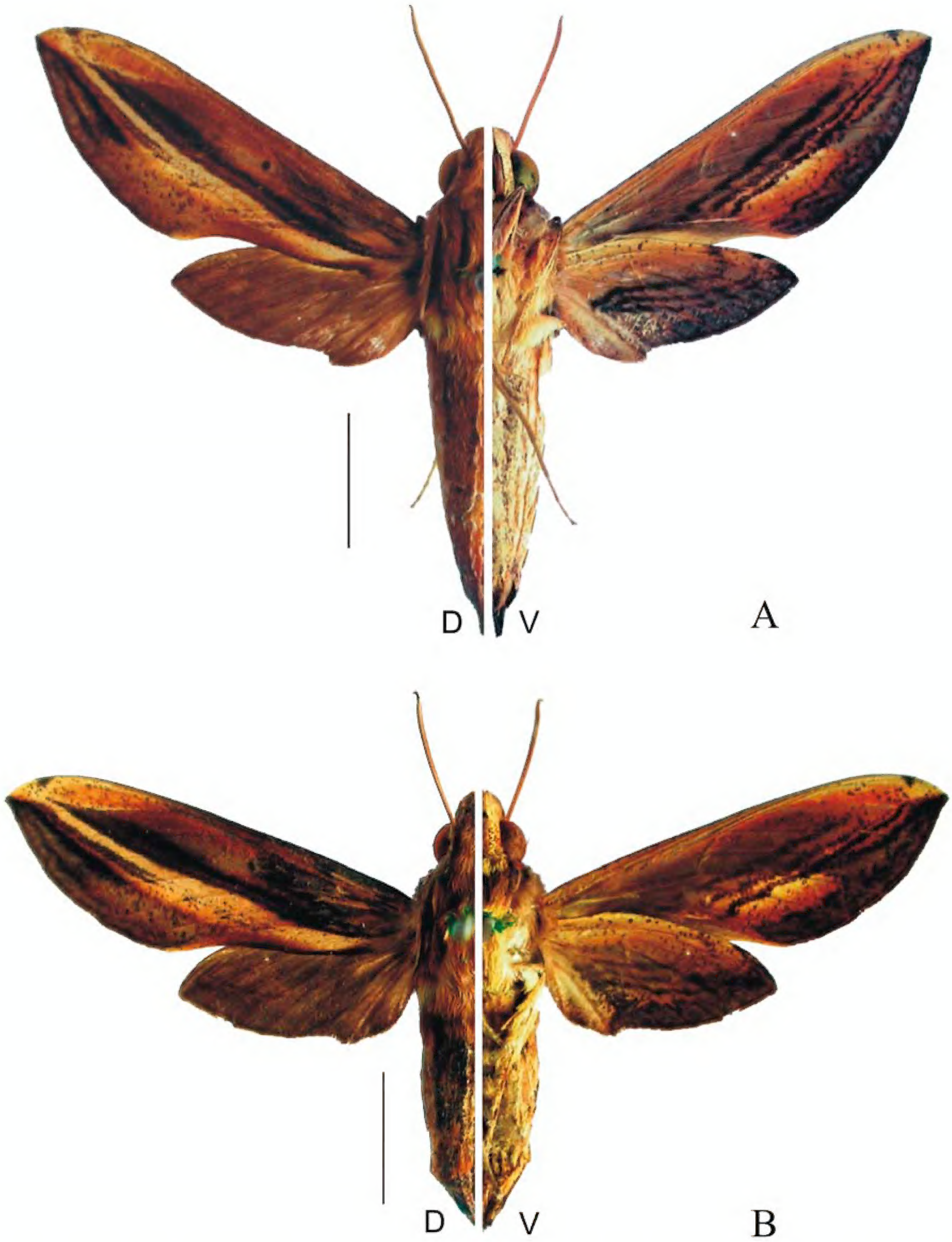

Figure 3. *Xylophanes t. thyelia* (Linnaeus, 1758) (Macroglossinae: Macroglossini). Abundant species collected year-round at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil. A, male; B, female. (D, dorsal; V, ventral). Scale bar = 10 mm.

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Table 4. Species frequency distributions of hawkmoths (Lepidoptera: Sphingidae) with different number of individuals collected at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil.

Individuals per species	Number of species		Individuals per species	Number of species	
	Observed	Log series		Observed	Log series
1	14	15.1085	39	2	0.2930
2	3	7.4989	40	-	0.2836
3	4	4.9627	41	-	0.2747
4	1	3.6948	42	3	0.2662
5	2	2.9342	43	2	0.2581
6	3	2.4273	44	1	0.2504
7	1	2.0653	45	-	0.2430
8	-	1.7939	46	-	0.2360
9	-	1.5829	47	-	0.2293
10	-	1.4142	48	3	0.2229
11	1	1.2762	49	-	0.2167
12	3	1.1613	50	-	0.2108
13	4	1.0641	51	-	0.2052
14	-	0.9809	52	-	0.1998
15	1	0.9088	53	-	0.1945
16	1	0.8457	54	-	0.1895
17	-	0.7902	55	1	0.1847
18	-	0.7408	56	-	0.1801
19	3	0.6967	57	-	0.1757
20	3	0.6570	58	-	0.1714
21	1	0.6211	59	2	0.1672
22	-	0.5886	60	-	0.1632
23	2	0.5589	61	-	0.1594
24	1	0.5316	62	-	0.1557
25	-	0.5066	63	-	0.1521
26	-	0.4836	64	-	0.1486
27	1	0.4623	65	-	0.1452
28	1	0.4425	66	1	0.1420
29	-	0.4241	67	-	0.1389
30	-	0.4070	68	-	0.1358
31	-	0.3910	69	-	0.1329
32	-	0.3760	70	1	0.1300
33	-	0.3619	and with 75, 77, 85, 128, 153 e 190.		
34	2	0.3487			
35	-	0.3363			
36	-	0.3245			
37	1	0.3134			
38	-	0.3030			
Total number of species	75				
Total number of individuals	2064				

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Table 5. Phenology of the hawkmoths (Lepidoptera: Sphingidae) collected at the *Estação Biológica de Boracéia*, Salesópolis, São Paulo, Brazil.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Macroglossinae : Dilophonotini													
Aellopos	*fadus*	X											
Aellopos	*titan titan*	X									X	X	X
Callionima	*inuus*	X	X	X	X			X	X	X			
Callionima	*nomius*	X	X	X	X	X		X	X		X	X	X
Callionima	*parce*	X	X	X	X			X	X	X			X
Enyo	*lugubris lugubris*	X	X			X		X	X	X	X	X	X
Enyo	*ocypete*	X							X	X	X	X	
Erinnyis	*alope alope*	X	X	X	X		X	X	X	X		X	X
Erinnyis	*crameri*	X	X	X	X	X	X	X	X	X	X	X	
Erinnyis	*ello ello*	X	X		X			X	X		X	X	X
Erinnyis	*lassauxii*						X	X	X	X		X	
Erinnyis	*obscura obscura*				X		X			X	X	X	X
Erinnyis	*oenotrus*	X	X	X	X			X	X	X	X	X	X
Hemeroplanes	*longistriga*	X		X				X					
Hemeroplanes	*ornatus*												X
Isognathus	*caricae caricae*									X			
Madoryx	*plutonius plutonius*			X									
Nyceryx	*coffaeae*			X									X
Nyceryx	*continua continua*	X	X	X	X				X	X	X		
Nyceryx	*nictitans nictitans*	X	X			X			X		X	X	X
Pachylia	*ficus*			X					X	X	X		X
Pachylia	*syces syces*								X				
Pachylioides	*resumens*	X							X	X	X	X	X
Perigonia	*passerina*	X							X				
Perigonia	*stulta*	X	X	X	X	X		X	X		X	X	X
Pseudosphinx	*tetrio*	X			X			X	X	X	X		
Macroglossinae : Philampelini													
Eumorpha	*analis*	X	X	X	X								X
Eumorpha	*anchemolus*	X	X		X			X		X	X	X	X
Eumorpha	*fasciatus fasciatus*	X	X			X					X	X	X
Eumorpha	*labruscae labruscae*							X	X	X			X
Eumorpha	*megaeacus*		X	X								X	
Eumorpha	*obliquus obliquus*	X	X						X	X	X	X	X
Eumorpha	*translineatus*	X	X										X
Macroglossinae : Macroglossini													
Hyles	*euphorbiarum*									X			
Xylophanes	*aglaor*	X	X	X	X		X	X	X	X	X	X	X
Xylophanes	*ceratomioides*	X	X	X	X						X	X	X
Xylophanes	*chiron nechus*	X	X	X	X		X	X	X	X	X	X	X
Xylophanes	*indistincta*							X					
Xylophanes	*isaon*	X	X	X					X	X	X	X	

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Table 5. Continued.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Macroglossinae : Macroglossini													
Xylophanes	*loelia*				X								
Xylophanes	*marginalis*									X	X		
Xylophanes	*pistacina*											X	X
Xylophanes	*pluto*	X					X	X	X	X	X	X	
Xylophanes	*porcus continentalis*	X	X	X	X				X	X	X		X
Xylophanes	*schausi schausi*			X									
Xylophanes	*tersa tersa*	X	X	X	X			X	X	X	X	X	X
Xylophanes	*thyelia thyelia*	X	X	X	X	X	X	X	X	X	X	X	X
Xylophanes	*titana*	X	X		X				X	X	X	X	
Xylophanes	*xylobotes*	X	X	X	X	X	X	X	X	X	X		X
Smerinthinae : Ambulycini													
Adhemarius	*daphne daphne*				X								
Adhemarius	*eurysthenes*	X	X	X	X	X	X	X	X	X	X	X	X
Adhemarius	*gagarini*		X										
Adhemarius	*gannascus*	X	X	X	X		X	X	X	X	X	X	X
Adhemarius	*palmeri*				X								
Protambulyx	*eurycles*	X	X						X		X		X
Protambulyx	*strigilis*	X	X	X	X	X		X	X		X	X	X
Sphinginae : Sphingini													
Amphimoea	*walkeri*		X										
Cocytius	*antaeus*						X		X	X			
Cocytius	*beelzebuth*	X							X				X
Cocytius	*duponchel*	X	X	X	X	X	X	X	X	X	X	X	
Cocytius	*lucifer*		X		X			X	X		X		
Manduca	*albiplaga*	X	X										
Manduca	*brasilensis*	X	X	X	X				X	X	X	X	X
Manduca	*dalica anthina*	X	X	X								X	X
Manduca	*diffissa petuniae*	X	X		X	X				X	X	X	X
Manduca	*florestan*	X	X		X	X		X	X		X	X	X
Manduca	*hannibal*							X					
Manduca	*incisa*										X		
Manduca	*lichenea*								X	X	X		
Manduca	*lucetius*	X	X							X	X		
Manduca	*rustica rustica*	X		X					X		X	X	
Manduca	*sexta paphus*	X	X	X						X		X	
Neococytius	*cluentius*	X	X				X	X	X	X	X	X	X
Sphinx	*justiciae*		X	X	X							X	X
Sphinginae : Acherontiini													
Agrius	*cingulata*	X	X					X	X	X	X	X	X

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